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IV.

THE FOSSIL WHITE ANTS OF COLORADO.

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Presented October 10, 1883.

THE family of Termitina is represented in the tertiaries of Europe by twenty-nine nominal species. Hagen, however, asserts that several of those purporting to come from amber are in reality copal species; and this, with synonyms and species merely nominal, reduces the actual number to seventeen. It is doubtful if one of these, *T. Peccanæ* Massal., is a *Termes* at all, and if it is, its position cannot be further defined. The number may therefore be considered sixteen; besides this, a species has been indicated without name from the English tertiaries.

Of these sixteen, six come from amber, belonging to three genera (*Calotermes*, two species, *Termopsis* three and *Termes* one); six from Radoboj, also of three genera (*Hodotermes* two species, *Termes* two, and *Eutermes* two); and three from Oeningen, of two genera (*Hodotermes* two species, *Termes* one—the same as found at Radoboj). Besides these, there is a *Calotermes* from Rott, and a *Hodotermes* from Schossnitz.

The section comprising the genera having a branched scapular vein is therefore represented by eleven species (*Calotermes* three, *Termopsis* three—from amber only, *Hodotermes* five); while the section with simple scapular has only five species (*Termes* three, *Eutermes* two). The nominal and doubtful species (and, it might be added, most of the synonyms) fall into the latter section, and should doubtless increase it somewhat. As it stands, the first section has two thirds of the fossil species.

Thirteen of these sixteen species are entered in Hagen's *Monographie der Termiten*; the others have since been published; and it is noteworthy that of the eighty-four modern species contained in this monograph, fifty-five, or nearly two thirds, belong to the second section; in other words, only thirty-one per cent of the tertiary, but sixty-five per cent of the recent species, belong to the second section.

The additions to the tertiary Termite-fauna here made are in entire keeping with these statistics; six species are described, of which four belong to the first, and two to the second section, raising the number of tertiary species to twenty-two, or about one fourth the number of recent species.

Of these six species, three belong to a new extinct genus, apparently peculiar to America, but possibly including some of the species from the European tertiaries; another is referred doubtfully, from want of sufficient data, to *Hodotermes*, which has yielded species from Radoboj, Oeningen, and Schosnitz, as well as among modern types; while the other two probably fall into *Eutermes*, and are allied to, but considerably smaller than, the species from Radoboj placed with many modern types in the same genus. They are perhaps more nearly allied to, as they certainly agree better in size with, the two species of *Termes* found living in the neighboring valley of the Fontaine qui Bouille. *Calotermes*, which has furnished species from amber and the Rhenish basin, *Termopsis*, which has more fossil (amber) species than recent, and *Termes* proper, which is represented at Oeningen and Radoboj and in amber and the Rhenish basin, all seem to be wanting in the American tertiaries. The composition of the white-ant fauna of the ancient Florissant, to which locality the known American fossils are confined, differs considerably from that of the localities known in the European tertiaries, but resembles that of Radoboj more closely than it does any other, as will appear from the following table of representation.

First Division.

FLORISSANT.	RADOBOJ.
<i>Parotermes insignis</i> .	
“ <i>Hagenii</i> .	
“ <i>fodinæ</i> .	
<i>Hodotermes</i> ? <i>coloradensis</i> .	<i>Hodotermes</i> <i>Haidingeri</i> .
	“ <i>procerus</i> .

Second Division.

	<i>Termes</i> <i>pristinus</i> .
<i>Entermes</i> <i>fossorum</i> .	<i>Eutermes</i> <i>obscurus</i> .
“ <i>Meadii</i> .	“ <i>croaticus</i> .

Out of one hundred and fifty-three specimens of amber white ants examined by Hagen, only a single larva and no soldier was found; all other fossil individuals have also been winged specimens; but it is worthy of special remark, that in the collection of twenty-six indi-

viduals from Florissant one is a larva. The scarcity of such forms, whether in amber or lacustrine deposits, is easily explained by the habit of life of these creatures.

The very presence of so considerable a number of Termitina (twenty-six specimens, six species *) in the Florissant beds is indicative of a much warmer climate formerly than the locality now enjoys. Only three species of white ants, and of these only one belonging to the section with branched scapular vein, have been recorded from the United States north of the Gulf margin, excepting on the Pacific coast, where one or two more extend as far north as San Francisco. Yet seventeen species in all are recorded from North America by Hagen in 1861, and some have since been added to the list; while his South American list (nearly all from Brazil) includes thirty-one species, of which five are repeated from the North American list. Florissant is situated in 39° N. Lat., and Hagen says that the family only rarely (*wenig*), and that only in the Northern hemisphere, extends beyond the fortieth degree of latitude. One species occurs as far north as Manitoba.

TABLE OF GENERA.

Scapular vein branched.	
Submarginal vein present	<i>Parotermes</i> .
Submarginal vein absent	<i>Hodotermes</i> .
Scapular vein unbranched	
	<i>Eutermes</i> .

PAROTERMES nov. gen. (πάρος, Termes, nom. gen.)

Head rather large, short-oval in form, almost as broad anteriorly as posteriorly, well rounded behind; eyes small, ocelli wanting; antennæ longer than the head, but shorter than the head and prothorax, slender, perhaps slightly broader in the middle than at either end, composed of about twenty equal joints, shorter than broad. Prothorax from a half to a third as long as the head, narrower than or only as broad as it, broader in front than behind, subquadrate, with the hinder angles rounded off. Wings slender and straight, subequal, less than half as long again as the body, four times as long as broad; basal scale obscure in most specimens examined, moderately large, as long as the prothorax, its costal margin convex; costal margin of wing straight nearly to the tip, which tapers to a well-rounded point; marginal and

* According to Hagen (Linn. Ent., XII. 244), no locality in the world has yielded more than nine species of living types; they so rarely number more than four, that he had formerly indicated this as the limit, so far as known.

mediastinal veins both present, the latter distinct and reaching nearly to the middle (sometimes only to the end of the basal third) of the costal border; scapular vein running parallel to the costal margin to the tip of the wing and emitting from five to seven very oblique gently curving superior branches at partly regular intervals, the second arising before the middle of the vein; it also emits a couple of inferior branches from opposite the base of two of the later branches which strike the apex of the wing, diverging from the main vein no more than the superior branches. Externomedian vein also running parallel to the costal margin throughout the greater part of the wing, and not so far removed from the scapular as the latter is from the costal margin; it has four or five simple or forked branches, mostly arising in the basal third of the wing, and with these branches takes a remarkably longitudinal course obliquely toward the hind margin and parallel to the inferior apical branches of the scapular vein; it therefore occupies the greater part of the wing. The internomedian vein is reduced to a very contracted area, consisting apparently of only a single forked vein or two in the narrowing basal part of the wing. The feeble character of the externomedian and internomedian veins, as well as of the inferior branches of the scapular vein, prevents their preservation on most of the fossils, and it is only in a few specimens that the whole or nearly the whole can be made out. There is apparently no network or reticulation anywhere on the membrane of the wing. The abdomen is large and ovate, generally broader than the rest of the body.

This genus, which is most nearly allied to *Termopsis* and *Calotermes*, differs from each of them in points wherein they differ from each other, and has some peculiarities of its own. It differs from *Calotermes* in its shorter wings (relative to the length of the body), which lack any fine reticulation, and in its want of ocelli. From *Termopsis* it differs in its slenderer but yet shorter wings, without reticulation, its uniform scapular vein, running parallel to the costa throughout and provided with fewer and straight branches. From both it differs in the presence of distinct inferior branches to the scapular vein, but especially in the slight development of the internomedian vein, the excessive area of the externomedian vein, and the course of the latter, which is approximated much more closely than usual to the scapular vein and emits branches having an unusually longitudinal course. These last peculiarities also separate this genus still more widely from *Hodotermes*, with which it agrees pretty closely in many points, and in which Hagen places most of the

larger Termitina described by Heer from the European tertiaries, although they do not appear to agree with the characteristics of the genus as given by him, and certainly approach in some of their features the peculiarities of the present genus. It is however impossible from Heer's figures alone to judge whether they are really more closely allied to Hodotermes or Parotermes; a nearer examination of the types themselves would perhaps decide; but at present Parotermes must be considered peculiar to the American tertiaries.

The species are all of pretty large size. They may be separated as follows:—

Abdomen considerably broader than the thorax.

Wings produced at the apex; submarginal vein short; branches of the externomedian vein and inferior branches of scapular more oblique than the superior scapular branches 1. *P. insignis*.

Wings rounded at the apex; submarginal vein long; branches of the submedian vein and inferior branches of the scapular as longitudinal as the superior scapular branches 2. *P. Hagenii*.

Abdomen no broader than thorax 3. *P. fodinæ*.

PAROTERMES INSIGNIS nov. sp.

Head broad oval, of pretty regular shape, but broadest in the middle of the hinder half, the front and hind border broadly rounded; there is a slight median longitudinal suture in the posterior half of the head. Eyes one fifth the diameter of the head, situated with the front margin slightly more distant from the front than from the hind border of the head and the outer margin just within or at the lateral margin of the head; they do not appear to project strongly above the surface. Antennæ scarcely so long as the head and prothorax together, composed of about twenty to twenty-two joints, the basal joints twice as broad as the stem, the others broader than long and equal throughout, not enlarged toward the middle of the antennæ.

Pronotum nearly twice as broad as long, as broad as the head, the front margin nearly straight with slightly rounded corners, the hind border and sides forming one nearly uniform broad semicircular curve; its surface appears to be flat, or at least there is no median impressed line. Mesonotum a fourth broader than long, with a distinct median impressed line, at least in the front half, subquadrate in shape, broadest in the middle of the front half, and tapering slightly and regularly behind, the front margin broadly rounded to the shoulder of the wing. Metanotum about as long as the mesonotum and of a similar shape, but tapering more rapidly behind, and likewise with a median impressed line more distinct anteriorly.

Abdomen obovate, broad and about equally rounded at either end, in the middle nearly half as broad again as any other part of the body, in length just about equalling the entire thorax. Abdominal appendages obscurely seen in a single individual, where they are tolerably stout, tapering slightly, very bluntly terminated, and about as long as the last abdominal segment.

Legs very short, the tibiae being shorter than the width of the thorax, and armed at tip with a pair of short straight spurs; tarsi not more than half as long as the tibiae, but the separate joints are not determinable on any of the specimens.

Wings four times as long as broad, the middle of the front pair reaching the end of the abdomen, long and very regularly obovate, the only difference in the form of the two extremities being in the gentler tapering of the base, and the straighter course of the costal margin next the base. The basal scale is triangular, about as long as the mesonotum, its costal and outer margins each a very little convex. The scapular vein, its superior branches, and the mediastinal, are stout, while the other veins are very feeble and only appear under favorable preservation. The submarginal vein* is crowded against the margin, but does not run fairly into it before the end of the basal fifth of the wing. The mediastinal vein terminates a short distance before the middle of the wing. The scapular vein runs at only a short distance from and parallel to the margin, and emits from five to eight superior branches running in an extremely longitudinal course to the costa; usually the first branch is thrown off almost as far out as the middle of the second quarter of the wing, but where the branches are numerous three branches are thrown off before the middle of the wing; in addition to the superior veins two inferior veins are emitted in the apical third of the wing, and strike the lower margin of the wing just below the apex. The externomedian vein runs subparallel to, but a little divergent from, the scapular, and nearly as far from it as it is from the costal margin, emitting four inferior simple or forked branches which cover the greater part of the hind border with their nervules; from near the middle of the wing a superior branch is also emitted, which is soon lost. The internomedian vein is forked, and strikes the margin near the middle of the basal half.

Although in the number of branches to the scapular vein the speci-

* What I here call the submarginal vein is the short simple vein, sometimes present in, at other times absent from *Termitina*, which precedes the mediastinal vein. Hagen calls it the first branch of his subcosta.

men showing the wings most clearly (No. 7752) differs considerably from the others, the vein commencing to branch at a considerably earlier point, all the specimens agree so well in every other particular that these would appear to be individual variations. It is the largest species of the genus.

Length of body, 11.5 mm.; breadth of thorax, 2.5 mm.; of abdomen, 3.3 mm.; length of antennæ, 4.25 mm.; of front wing, 13.3 mm.; breadth of same, 3.35 mm.; length of middle tibia, 2 mm.; of tarsi, 1.25 mm.; of abdominal appendages, 0.65 mm.

Florissant. 4 specimens. Nos. 400, 7752, 9041, 14400.

PAROTERMES HAGENII nov. sp.

Head roundish obovate, very regularly rounded, scarcely half as long again as broad, broadest at the eyes, which are scarcely behind the middle, and are deeply set, their outer border projecting but little beyond the contour of the head. Antennæ nearly as long as head and pronotum taken together, composed of about twenty-six joints, subequal beyond the base, a little tapering at the tip.

Pronotum more than twice as broad as long, fully as broad as the head, the front margin slightly concave, the hind border and sides forming a regular broad curve. Mesonotum and metanotum shaped exactly as in *P. insignis*, and with a similar impressed line.

Abdomen obovate, but with more parallel sides than in *P. insignis*, being only a little broader than the thorax, and nearly as long as the rest of the body, including the head. Abdominal appendages tolerably slender, equal, bluntly pointed, composed of five or six joints, the last of which appears to be two or three times as long as the others, which are equal; the whole is about half as long as the pronotum.

Legs short, but longer than in *P. insignis*, the tibiæ being about as long as the width of the thorax, but they are imperfectly preserved on all the specimens.

Wings a little more than four times longer than broad, the middle of the front pair scarcely reaching the extremity of the abdomen, broadest in the middle, tapering almost as much apically as basally, the tip roundly pointed, the costal margin pretty straight until shortly before the tip, the lower margin broadly curved. The basal scale is of the same shape and size as in *P. insignis*, but with a stronger costal curve. The scapular vein and its superior branches are stout, its inferior branches and the veins below feeble, so as only to appear under favorable circumstances, being visible in only half of the speci-

mens before me. The submarginal vein of the front wing terminates at about the middle of the basal half of the wing, and about opposite the origin of the first superior scapular branch. The mediastinal vein extends about to the middle of the wing, both in the front and hind wings. The scapular vein is related to the margin exactly as in *P. insignis*, and has five or six superior branches on the hind wing, six or seven on the front wing; on the front wing they originate at subequal distances apart, commencing usually at about the middle of the basal half of the wing, but when there are but six branches (which appears to be less commonly the case) the first originates at a greater distance from the base; on the hind wing there is greater irregularity; in one specimen there are five branches on the left hind wing, the first originating beyond the middle of the wing, while on the right wing there is an additional vein, originating far before the second, at the middle of the basal half of the wing; in another specimen (No. 8250) with only five veins, the basal branch originates somewhat beyond the middle of the basal half of the wing, and the others follow at subequal intervals; besides these superior, there are two inferior nervules arising, the first at the end of the middle third of the wing, opposite a superior branch, and the second opposite the succeeding branch; sometimes a third vein appears beyond these; after parting from the scapular vein these take a longitudinal course and terminate at the tip of the wing. The externomedian vein runs subparallel to the scapular, diverging slightly from it and being as far from it as it is from the costal margin; it emits two or three inferior branches, the last scarcely beyond the middle of the wing, the basal ones of which appear to be forked, but all having an unusually longitudinal course, being only slightly deflected toward the lower margin. Nothing can be said of the internomedian vein.

This species differs from *P. insignis* by its more laterally disposed eyes, rounder head, differently shaped wings, more longitudinally disposed branches of the externomedian vein, and longer and narrower abdomen.

Length of body, 10.5–12, av. 11 mm.; breadth of thorax, 2.1 mm.; of abdomen, 2.6 mm.; length of antennæ, 4 mm.; of front wing, 13.5–15.5, av. 14 mm.; breadth of same, 3.35 mm.; length of middle tibia, 1.65 mm.; of abdominal appendages, 0.65 mm.

Florissant. 7 specimens. Nos. 4629, 4652, 5224, 6030, 8250, 8616, 14167.

PAROTERMES FODINÆ nov. sp.

Head oblong obovate, half as long again as broad, the eyes large, circular, about one fifth the diameter of the head, slightly projecting beyond the sides, the anterior edge near the middle of the head.

Pronotum transversely lunate, as broad as the head, less than twice as long as broad, the front margin regularly and considerably concave, the hind margins and sides forming one uniform strongly convex curve, the anterior lateral angles rounded off. Meso- and metanotum obscurely preserved, but apparently formed much as in the other species, the mesonotum being of about the same width as the pronotum.

Abdomen rather long and comparatively slender, scarcely if at all exceeding in width the parts in front, the sides being unusually parallel, the tip well rounded, the whole as long as the rest of the body. Abdominal appendages very small, stout, being only a little more than twice as long as broad, largest in the middle, and tapering either way, the tip blunt, the whole not longer than the diameter of the eye.

Legs poorly and partially preserved in a single specimen, showing them to be much as in *P. Hagenii*, the hind tibia being only a little shorter than the width of the mesothorax.

Wings four times as long as broad, the middle of the front pair reaching the tip of the abdomen; the exact form cannot be made out, but the costal margin is straight until very near the tip, and the hind border appears to be uniform and to make the wing slightly broadest just beyond the middle. The submarginal vein is unusually long, running into the costa only a little before the middle of the wing. The mediastinal terminates not far beyond the middle. The scapular vein has five or six branches in the front wing, generally five in the hind wing, the first appearing always to originate at the end of the basal third of the wing. The inferior nervules of this vein and the course of the branches of the veins below cannot be determined in any of the specimens, but there are faint indications of their presence, and nothing in them appears to distinguish this species by any marked peculiarities from the others of the genus.

This species differs from the others here described in its considerably smaller size, slender abdomen, and much smaller abdominal appendages.

Length of body, 9 mm.; breadth of thorax, 2 mm.; length of front wing, 13 mm.; breadth of same, 3.25 mm.; length of hind tibia, 2 mm., of abdominal appendages, 0.25 mm.

Florissant. 4 specimens. Nos. 1247, 1253, 7608, 11190, and 14391.

HODOTERMES HAGEN.

Hagen refers to this genus two fossil species from Oeningen and two from Radoboj. Assmann also describes a species from Schossnitz, and one of the Florissant white ants is referred here doubtfully. The fossil therefore nearly equal in number the living species, which are all inhabitants of the Old World, the most northern species being found in Egypt.

HODOTERMES? COLORADENSIS nov. sp.

Metanotum considerably narrower than the mesonotum, as long as broad, tapering posteriorly, the front border straight, the hind border rounded.

Abdomen ovate, stout, less than twice as long as broad, the sides full, as broad as the mesothorax, posterior extremity rounded. Abdominal appendages long and slender, half as long as the metanotum, composed of at least six or seven joints, slightly tapering, terminating very bluntly.

Wings very long, the middle of the front pair lying far beyond the tip of the abdomen. Submarginal vein absent from all the wings. Mediastinal vein terminating at the middle of the front border. Scapular vein parallel to the front margin, with at least four branches in both wings, and in the front pair pretty certainly five branches, and perhaps six; the first branch originates in the front wing at the end of the basal fourth of the wing, in the hind wing a little farther out.

This species is readily distinguished from all the other fossil Termitina of North America by its very great size, the length of the wings being double that of any other. Although the specimen is very imperfect, the tip and lower half of the wings being absent, as well as the head, prothorax, and legs, it differs so much from the species of Parotermes, in the absence of the submarginal vein and the great length of the abdominal appendages, that it cannot probably be associated with them generically. In size and general appearance it agrees so fairly with the tertiary species described by Heer, referred to Hodotermes by Hagen, that I place the species provisionally in the same genus, with which (as with all other genera so far as I know in which the structure of the wings would allow it to be placed) it differs by the great length of its anal appendages.

Length of body as preserved, 9 mm. (probably it reached about 12); of abdomen, 6 mm.; breadth of same, 4.5 mm.; length of forewing,

23 mm. or more; of abdominal appendages, 1.25 mm.; breadth of same, 0.3 mm.

Florissant, No. 6010.

EUTERMES HEER.

The remaining species fall into the division of Termitina in which the scapular vein is unbranched, and it is uncertain whether they should fall in Termes proper or in Eutermes, the veins below the scapular being in all cases poorly preserved or wholly obliterated. The limited number of antennal joints in such as have these preserved sufficiently for examination, and the occasional indication of a broad subscapular field in others, leads rather to the presumption that they should be placed in Eutermes. Two species have been found at Florissant. The genus has been well known in a fossil state, four species having been described from Radoboj in Croatia, and five from Prussian amber. Indeed, the genus was first founded upon fossil species, but it was soon seen that many living forms belonged to the same group. The existing species, some thirty in number, belong almost exclusively to the tropics, and especially to those of the southern hemisphere.

The two species of Eutermes which have been found at Florissant may be separated by the following features:—

Head broader behind than in front, scarcely half as long again as broad.

Pronotum semicircular, the posterior curve uniform. . . . 1. *E. fossarum*.

Head not broader behind than in front, fully half as long again as broad.

Pronotum very short, the hind margin more or less truncate. 2. *E. Meadii*.

EUTERMES FOSSARUM nov. sp.

Head very regularly obovate, a little broader behind than in front, nearly half as long again as broad, its posterior border well rounded. Eyes rather small, situated in the middle laterally, projecting but little. Antennæ scarcely if any longer than the head, rather stout, enlarging away from the base, composed apparently of less than fifteen joints.

Pronotum as broad as the head and twice as broad as long, semicircular, the front border scarcely concave, the front margins slightly rounded. Meso- and metanotum as broad as pronotum, quadrate, equal, about half as broad again as long.

Abdomen somewhat longer than the rest of the body, and slightly

broader than the thorax, with gently rounded sides and well-rounded tip; no appendages are discoverable on any of the specimens.

Legs poorly preserved on all specimens; apparently they are of medium length.

Wings rather more than four times as long as broad, the middle of the front pair not reaching the tip of the abdomen, very uniform and regular, of nearly equal breadth throughout the middle two-thirds, the costal margin straight until just before the tip. Scapular vein parallel to the margin, the subcostal area infumated; veins below the scapular not determinable. The basal scale appears to be small, broad, triangular, its costal border swollen.

Length of body, 6.5–7.5, av. 7.15 mm.; of abdomen, 3.5–4.5, av. 4.15 mm.; breadth of pronotum, 1.2 mm.; of abdomen, 1.5 mm.; length of antennæ, 1.2 mm.; of front wing, 7.75–9.25, av. 8.25 mm.; breadth of same, 2 mm.

Florissant. 5 specimens. Nos. 2329, 6049, 7393, 11752, 14980, three of them in pretty good condition.

EUTERMES MEADII nov. sp.

Head very regularly obovate, broadest just behind the middle, where the small eyes, scarcely projecting, are situated, not broader behind than in front, the hind margin strongly rounded, the whole fully half as long again as broad. Antennæ nowhere well preserved, but apparently longer and with more numerous joints than in *E. fossarum*.

Pronotum as broad as the head (?) and very short, probably more than twice as broad as long, the hind margin not forming with the sides a continuous curve, but in its middle half only slightly convex. Meso- and metanotum quadrate, broader than the head, the mesonotum somewhat the larger, at least half as broad again as long.

Abdomen rather stout, longer than the rest of the body, the sides nearly parallel, the tip broadly rounded, and, as far as can be made out, unprovided with terminal appendages.

Legs moderately long and stout, the tibiæ armed with a pair of spines at apex, the front tibiæ about as long as the pronotum.

Wings long, slender, and uniform, four times or slightly less than four times as long as broad, the middle of the front pair reaching the tip of the abdomen, broadest at or slightly beyond the middle, the lower border slightly arcuate throughout. Costal margin straight in the basal three-fourths of the wing. Scapular vein parallel to the margin, the subcostal area scarcely infumated. Veins below the scap-

ular not determinable. Basal scale small, triangular, equilateral, the sides straight excepting the costal, which is very slightly convex and prominent.

This species differs from the preceding by its slightly smaller size, squarer pronotum, and differently shaped head.

Length of body, 5.25-7, av. 6.3 mm.; of abdomen, 2.8-3.5, av. 3.2 mm.; breadth of abdomen, 1.5 mm.; length of wing, 7.5-8 mm.; breadth of same, 2 mm.

Florissant. 4 specimens. No. 19 (Coll. T. L. Mead), and Nos. 31, 1203, 8062.

A single specimen of a wingless white ant has been found, apparently belonging to this species or to *E. fossarum*. It measures 3.75 mm. in length, and is of the ordinary form of the worker, with rounded head and constricted prothorax, bearing a general resemblance to the only other known fossil termite larva, figured in Berendt's work, but has the head more produced anteriorly and the abdomen less distended.

Florissant, No. 6100.

Illustrations of these species will appear in a Government Report in preparation.